

**U.S. Army Operation Enduring Freedom  
Deployment Injury Surveillance Summary  
1 January–31 December 2013  
PHR No. S.0047240-16**

**Approved for public release, distribution unlimited**

**General Medical: 500A, Public Health Data**

**October 2016**



## **FOREWORD**

This is the closeout report for the surveillance of in-theater hospitalizations, out-of-theater air evacuations, and fatalities for injuries occurring in relation to operations in Iraq and Afghanistan from 2001 through 2013. Under the authority of Army Regulation 40-5, Medical Services, Preventive Medicine, the Injury Prevention Division of the Army Public Health Center was tasked with collecting, analyzing, reporting, and archiving information pertaining to Army personnel injuries as well as identifying Army populations at risk of injury, and the associated risk factors and causes of injury. With this report, for Soldiers deployed in support of Overseas Contingency Operations from 2001 through 2013, this objective has been achieved.

Operation Iraqi Freedom officially ended on September 1, 2010, when U.S. forces began Operation New Dawn in Iraq, officially signifying an end to combat operations and the beginning of a continuing role of training, advising, assisting, and equipping the Iraqi Security Forces as well as conducting counterterrorism. Subsequently, December 15, 2011 marked the formal end of military operations in Iraq.

In Afghanistan, Operation Enduring Freedom was ongoing at the end of 2013 and has since officially ended on December 28, 2014. In 2015, the succeeding mission, Operation Freedom's Sentinel, commenced to maintain achievements of the previous 13 years and help Afghan security forces assume responsibility for the security of their country.

Due to the present smaller number of deployed Soldiers, and consequently, smaller number of in-theater hospitalizations, out-of-theater air evacuations, and fatalities for injuries occurring in relation to operations in Iraq and Afghanistan, further reporting at this time would be practically uninformative on an annual basis. However, surveillance will continue, as it could be informative collectively over time or with other uniformed services.

Project documents are archived at <http://www.dtic.mil/dtic/>.

**Prepared by:**

Avni Patel  
Bonnie Taylor  
Keith Hauret  
Bruce Jones

**Executive Summary**  
**Public Health Report No. S.0047240-16**  
**U.S. Army Operation Enduring Freedom**  
**Deployment Injury Surveillance Summary**  
**1 January–31 December 2013**

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## **1 Purpose**

The goals of this report on injuries to Soldiers engaged in Operation Enduring Freedom are to—

- Describe the relative impact of injuries (battle and non-battle) compared to diseases for calendar year (CY) 2013.
- Document non-battle injury (NBI) rates and trends from 2003 to 2013.
- Identify leading causes and diagnoses of NBI for CY 2013.
- Summarize key U.S. Army Public Health (APHC) CY 2013 analytic deployment surveillance projects on injuries among deployed Soldiers.
- Make recommendations for the improvement of Army injury prevention based on data analyzed.

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## **2 Conclusions/Findings**

### **2.1 Routine Deployment Injury Surveillance Summary 2013, Army Operation Enduring Freedom**

Routinely collected air evacuation, in-theater hospitalization, and casualty data provide the basis for deployment injury surveillance during Army deployments in support of Operation Enduring Freedom. Non-battle injury (NBI) was notably the most significant cause of medical air evacuations. As in previous years, the proportion of air-evacuated NBIs was larger than that of battle injuries (BIs) and any other single category of disease. Unlike previous annual reports, NBI was the leading cause of Operation Enduring Freedom hospitalizations while BI was the second leading cause. The leading causes of these NBIs indicate that many are likely preventable. Timely reporting of injury rates, types, and causes should allow commanders and Army leaders to focus their attention on prevention strategies and policies during ongoing operations.

### **2.2 Special Analytic Deployment Injury Surveillance Project Summaries, 2013**

Non-battle injuries were a significant cause of mortality among troops deployed in support of Operation Enduring Freedom between 2001 and 2012 and Operation Iraqi Freedom/New Dawn between 2003 and 2011. Overall, Soldiers deployed to OIF/OND were 8 percent less likely to sustain a fatal NBI as compared to Soldiers deployed to Operation Enduring Freedom (OIF/OND:

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65 per 100,000 Soldier-years; Operation Enduring Freedom: 76 per 100,000 soldier-years; p=.03). For both operations, there was a downward trend in the rates over time. Leading causes of fatal NBIs included: motor vehicle accidents (OIF/OND: 34%; Operation Enduring Freedom: 18%); air transport accidents (OIF/OND: 12%; Operation Enduring Freedom: 27%); unintentional, handling of weapons/explosives (OIF/OND: 5%; Operation Enduring Freedom: 10%) and intentional, self-inflicted injuries (OIF/OND: 30%; Operation Enduring Freedom: 27%).

From 2001 through 2011, 4,382 (Operation Enduring Freedom) and 15,946 (Operation Iraqi Freedom/Operation New Dawn), Soldiers were air-evacuated from theater for NBIs. Fracture, dislocation, open wound, and crush NBI rates decreased over time ( $p<.05$ ). Decreases in these NBI rates were related to decreases in the rates for motor vehicle accident, crush/blunt trauma, fall/jump, slip/trip, and cut/pierce injuries ( $p<.05$ ). The only NBI rate to increase over time was internal injury. Injury rates for the upper and lower extremities, torso, and head/face/neck decreased ( $p<.05$ ). These decreases in the lower extremity NBI rates were related to decreases in fall/jump and slip/trip NBI rates ( $p<.05$ ).

### **3 Recommendations**

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- Link additional data sources, such as levels IV and V hospitalizations and disability records, to provide an enhanced description of deployment injuries and their outcomes.
- Continue investigations to identify potentially modifiable risk factors that contribute to the leading causes of injury.
- Focus attention on strategies to prevent injuries from the leading causes observed, that is, sports/physical training, falls/jumps, and land transport accidents.

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## **1 References**

References are listed in Appendix A.

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## **2 Authority**

Army Regulation (AR) 40-5, *Preventive Medicine*, 25 May 2007; Section 2-19.

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## **3 Background**

Injuries are a major health problem confronting U.S. military forces in garrison and combat operations (references 1-2). For past conflicts, data on injuries were available only after the conflicts. For more recent conflicts, there was timelier, on-going reporting of both battle injuries (BIs) and non-battle injuries (NBIs). Operations in Iraq (Operation Iraqi Freedom and Operation New Dawn [OIF/OND]) came to an end in 2011, shifting the focus of this report to Operation Enduring Freedom (OEF). For the present operations in Afghanistan, NBIs have accounted for a larger proportion of medical air evacuations than BIs or any other disease-diagnosis group (references 3-9). Previous deployment injury-surveillance reports have provided injury rates and trends that were used to develop targeted prevention efforts for causes of injury with the highest or increasing rates (references 8-11). To prevent injuries, knowledge of the causes of injuries is also needed. The data in this report are unique in that they identify the causes of BI and NBI. This report provides a foundation for setting deployment injury prevention priorities based on the magnitude, severity, and causes of injuries.

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## **4 Purposes**

The goals of this report on injuries to Soldiers engaged in Operation Enduring Freedom (OEF) are to—

- Describe the relative impact of injuries (battle and non-battle) compared to diseases for calendar year (CY) 2013.
- Document non-battle injury (NBI) rates and trends from 2003 to 2013.
- Identify leading causes and diagnoses of NBI for CY 2013.
- Summarize key U.S. Army Public Health (APHC) CY 2013 analytic deployment surveillance projects on injuries among deployed Soldiers.
- Make recommendations for the improvement of Army injury prevention based on data analyzed.

## **5 Methods**

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### **5.1 Population**

This report describes battle injuries (BIs) and non-battle injuries (NBIs) among all deployed Army Soldiers (Active Duty, Reserve, and National Guard) in support of Operation Enduring Freedom (OEF) from 1 January 2013 through 31 December 2013 that resulted in—

- Air evacuation from the U.S. Central Command (CENTCOM) area of responsibility (AOR),
- Hospitalization in the CENTCOM AOR, and/or
- Death.

### **5.2 Data Sources**

#### **5.2.1 Air-evacuated Injuries**

Injury data for Soldiers air evacuated from CENTCOM were obtained from the U.S. Transportation Command Regulating and Command & Control Evacuation System (TRAC<sup>2</sup>ES). These data were routinely collected and used to request and coordinate medical air evacuation of Service members with serious injuries and diseases.

#### **5.2.2 Hospitalized Injuries**

Standard Inpatient Data Records (SIDR) for hospitalizations in the CENTCOM AOR were obtained from the Patient Administration Systems and Biostatistics Activity (PASBA), a component of the Decision Support Center, Office of the Surgeon General. These electronic records were created from medical records that were forwarded to PASBA after Soldiers were hospitalized in CENTCOM. These SIDR records are the official electronic record of a hospitalization in a Department of Defense (DOD) medical facility.

#### **5.2.3 Fatal Injuries**

Data for the number and causes of NBI deaths, BI deaths, and for the number of deaths from disease were obtained from the Defense Casualty Information Processing System (DCIPS). These data were routinely collected and used for casualty tracking and mortuary affairs. The DCIPS is maintained by the Army's Casualty and Memorial Affairs Operations Center, U.S. Army Human Resources Command.

### **5.3 Identification and Description of Injury Cases**

#### **5.3.1 Relative Importance of Injury and Disease**

Primary Diagnosis Groups from the International Classification of Diseases, 9<sup>th</sup> Revision, Clinical Modification (ICD-9-CM) and BI/NBI/Disease indicators were used to determine the relative importance of injuries (NBI and BI) and diseases among Soldiers who were air evacuated from CENTCOM or hospitalized in CENTCOM.

### **5.3.2 Exclusion Criteria**

- A 60-day air-evacuation exclusion rule was used to avoid double counting of injured Soldiers who were air evacuated from CENTCOM on more than one occasion for the same diagnosis within a 60-day timeframe of the initial event. This exclusion criterion was applied to all out-of-CENTCOM air-evacuation movements.
- Similarly, a 30-day hospitalization exclusion rule was used so that multiple injury hospitalizations of a Soldier for the same diagnosis (3-digit ICD-9-CM code) within a 30-day timeframe of the initial event were represented as a single hospitalization in the analysis. This 30-day timeframe accounts for distinct injuries, considering that some injuries required multiple hospitalizations.
- Injuries that required air evacuation within CENTCOM only (that is, further evacuation from CENTCOM was not required) were excluded from the air-evacuation analyses.

### **5.3.3 Injury Rate Calculations**

Injury rates for NBIs and BIs were calculated in this report. An annual injury rate was determined by dividing the number of injured Soldiers for the year by the total number of deployed person-years for that year. Information for number of deployed persons per year was obtained from the Armed Forces Health Surveillance Branch (AFHSB), Defense Health Agency.

### **5.3.4 Causes of Injury (Non-Battle Injuries and Battle Injuries)**

- Air-evacuated Injuries. The intent (intentional and unintentional) and the causes of injury were identified from narrative patient histories in the air evacuation records. Trained coders used the North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG) No. 2050, 5<sup>th</sup> Edition (Military Agency for Standardization, 1989) coding scheme to categorize the causes of injury (reference 12).
- Hospitalized Injuries. The STANAG-coded causes of injury were already present in the in-CENTCOM hospitalization records (SIDR) from PASBA and were used to determine the intent and cause of injury.
- Fatal Injuries. Causes of fatal NBIs and BIs were identified from casualty reports in DCIPS records. As with the air-evacuation records, trained coders used the STANAG coding scheme to categorize the cause of injury.

### **5.3.5 Type of Injury by Body Region Matrices for Non-Battle Injuries**

- The NBIs were categorized into two subgroups: (1) acute traumatic injuries and 2) non-traumatic injuries. A matrix was used to categorize the injuries in each of the NBI subgroups by injury type (e.g., fracture, dislocation, sprain/strain, and so forth) and body region.
- The modified Barell injury matrix (reference 13) was used to display injury frequencies for acute traumatic NBIs (ICD-9-CM codes 800-995; see Appendix B) in a standardized format in which the type of injury is listed horizontally, across the top of the table, and the body region is listed vertically, along the left side of the table. Tables 3 and 5 show two Barell matrices; one includes only those NBIs that required out-of-CENTCOM air evacuation, and the other includes only those NBIs that required in-theater hospitalization.

- A similar matrix format was used to display the frequencies of non-traumatic injuries (subset of ICD-9-CM codes 719-739; see Appendix C). Tables 4 and 6 show two non-traumatic injury matrices; one includes only those NBIs that required out-of-CENTCOM air evacuation, and the other includes only those NBIs that required in-theater hospitalization.

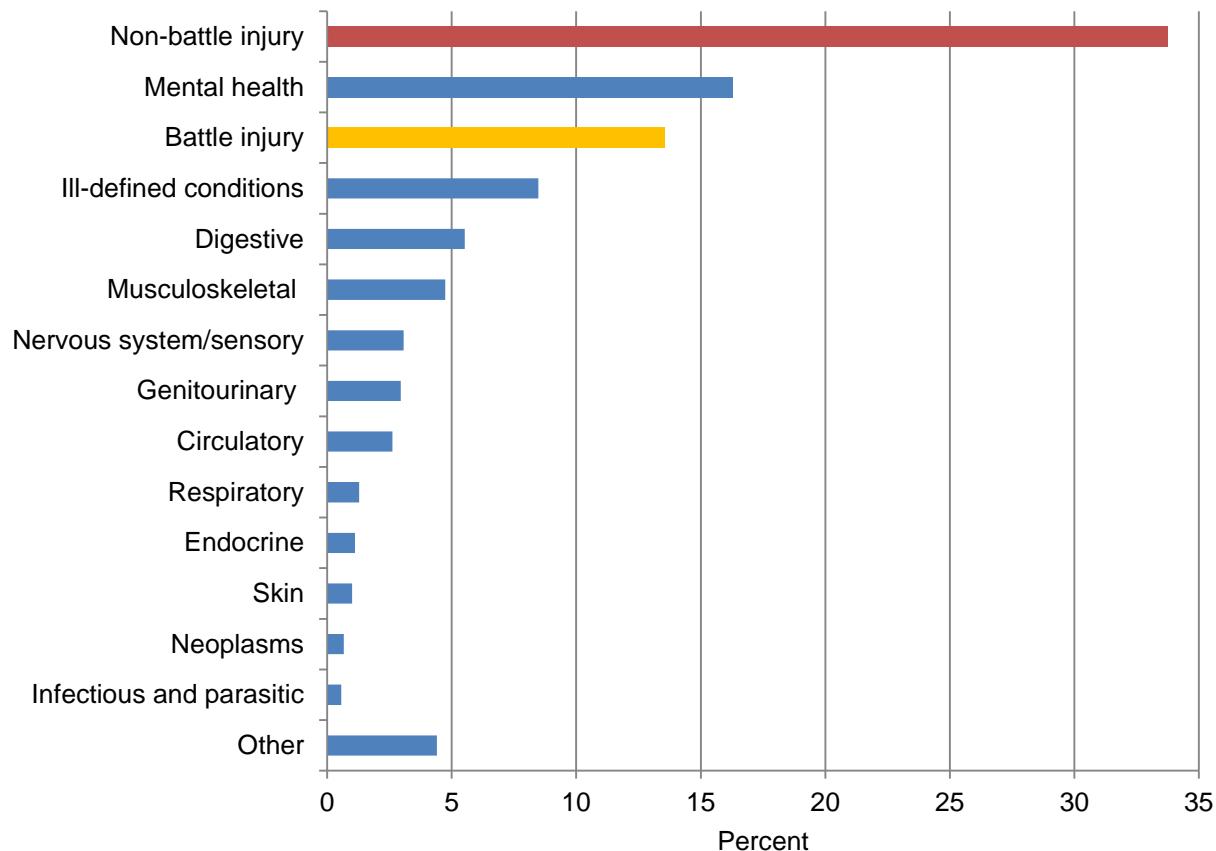
## **6 Results—Routine Deployment Injury Surveillance Summary, Army Operation Enduring Freedom, 2013**

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### **6.1 Distribution of Medical Air Evacuations by Primary Diagnosis Group, Operation Enduring Freedom**

Figure 1 shows the percentage of injuries and disease by primary diagnosis groups (ICD-9-CM code) for OEF out-of-CENTCOM medical air evacuations in calendar year (CY) 2013.

- In CY 2013, 1,793 Soldiers were medically air evacuated from Operation Enduring Freedom (OEF) to out-of-CENTCOM medical facilities.
- The non-battle injuries (NBIs) accounted for 34 percent ( $n=605$ ) of these OEF air evacuations. This proportion is considerably greater than that of the leading disease diagnosis group, mental health (16% [ $n=292$ ]). The battle injury (BI) category is the third leading cause of medical air evacuations (14% [ $n=243$ ]).
- The percentage of air evacuations for mental health (16%) is more than two times the percentage for the second leading specific disease category, digestive (6%).



**Figure 1. Distribution (Percentage) of Injury and Disease by Diagnosis Category among Air-evacuated Soldiers, Operation Enduring Freedom, CY 2013**

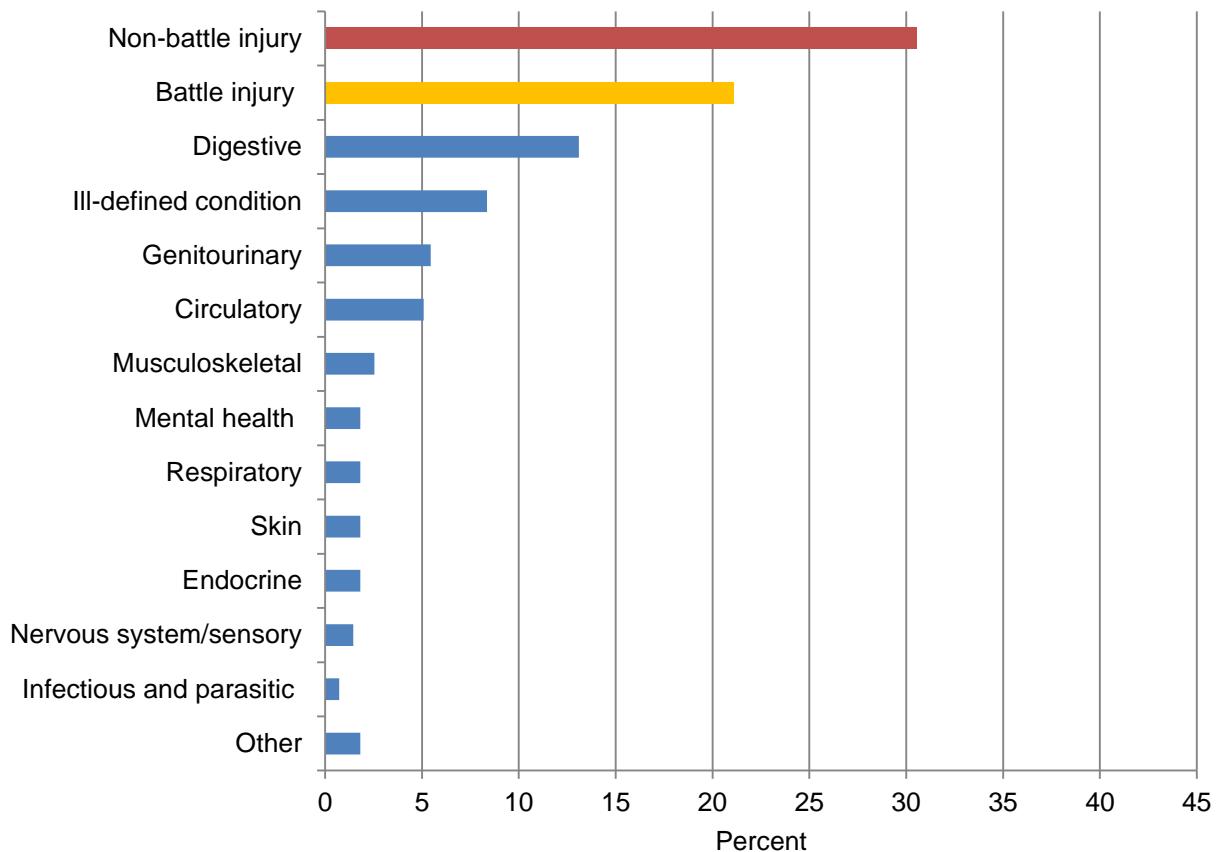
Note: Includes injury and disease resulting in out-of-CENTCOM air evacuation for 1,793 Soldiers.

## 6.2 Distribution of In-theater Hospitalizations by Primary Diagnosis Group, Operation Enduring Freedom

Figure 2 shows the percentage of hospitalized injuries and diseases by primary diagnosis groups (ICD-9-CM code) for OEF in CY 2013.

- In CY 2013, there were 275 hospitalizations in CENTCOM for OEF.
- The combined BIs (21%) and NBIs (31%) accounted for 52 percent (n=142) of hospitalizations. The leading specific disease category was digestive disorders (13% [n=36]).
- Although the NBI diagnosis group has consistently over time been the leading diagnosis group for air evacuations, BI was the leading diagnosis group for hospitalizations prior to 2013; 2013 marks

the first year since the beginning of OEF that NBI surpassed BI as the leading primary diagnosis group for hospitalizations.



**Figure 2. Distribution (Percentage) of Injury and Disease by Diagnosis Category among Hospitalized Soldiers, Operation Enduring Freedom, CY 2013**

Note: Includes injury and disease resulting in within-CENTCOM hospitalization (N=275).

### **6.3 Distribution of Air Evacuations, Hospitalizations, and Deaths by Injury Type, Operation Enduring Freedom**

Table 1 summarizes OEF injuries by injury casualty type in CY 2013.

- For every 1 NBI death in OEF in 2013, there were nearly 4 hospitalized NBI and 27 medically air evacuated NBI.

- Conservatively assuming no overlap among BI air evacuations (n=243), hospitalizations (n=58), and deaths (n=82), at least 63 percent of these BIs (total n=383) resulted in out-of-CENTCOM air evacuations, 15 percent in in-theater hospitalization, and 21 percent in death.
- These data show that in OEF during CY 2013, there were far more non-fatal injuries that resulted in medical-air evacuation and hospitalization combined than fatal injuries. These non-fatal outcomes result in significant lost duty time and decreased operational readiness for the Army.

**Table 1. Distribution of Air Evacuations, Hospitalizations, and Deaths<sup>1</sup> by Battle Injury and Non-Battle Injury among U.S. Army Soldiers Deployed for Operation Enduring Freedom, CY 2013**

	Battle Injury		Non-Battle Injury <sup>2</sup>	
	Number (n)	Row Percent (%)	Number (n)	Row Percent (%)
<b>Air Evacuations</b>				
<b>(n=848)</b>	243	28.7	605	71.3
<b>Hospitalizations</b>				
<b>(n=142)</b>	58	40.8	84	59.2
<b>Deaths</b>				
<b>(n=104)</b>	82	78.8	22	21.2

Notes:

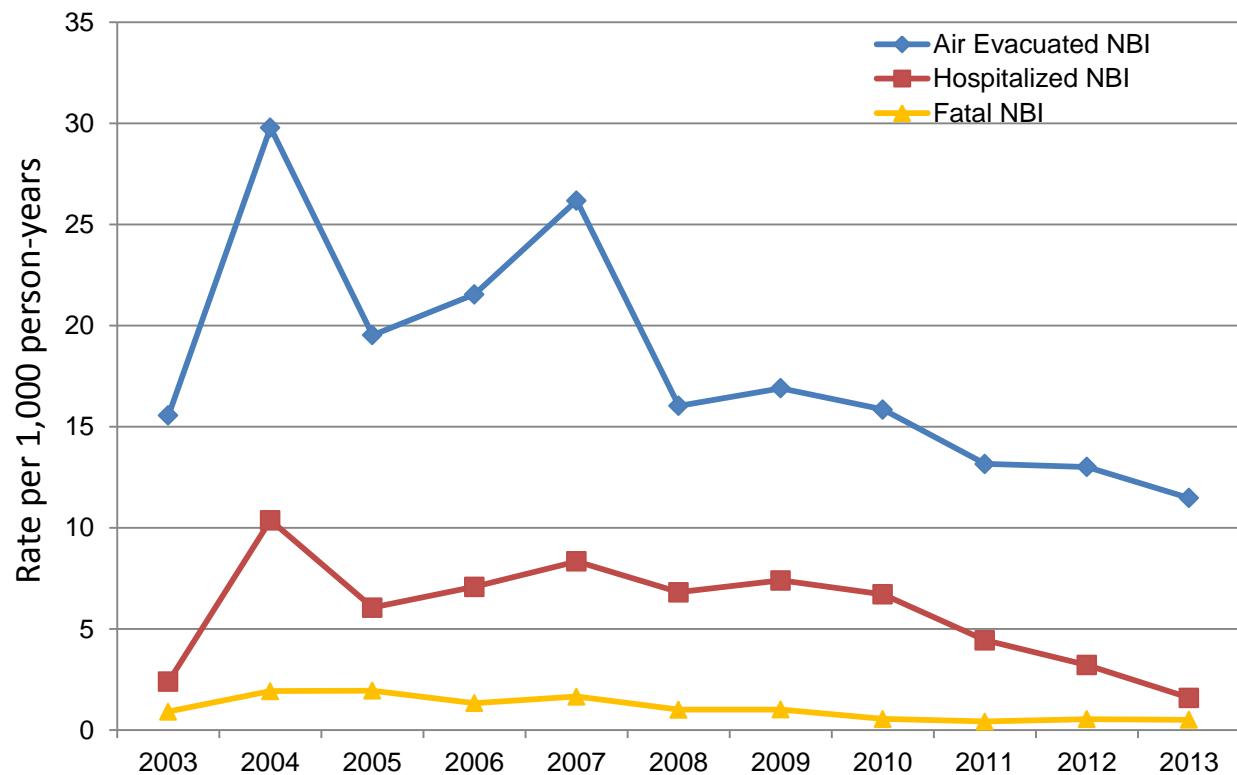
<sup>1</sup>Air evacuation, hospitalization, and death categories are not mutually exclusive.

<sup>2</sup>Includes acute injuries and injury-related non-traumatic injuries.

#### 6.4 Non-Battle Injury Rates, Operation Enduring Freedom

Figure 3 illustrates the annual NBI rates for air evacuations, hospitalizations, and deaths from 2003 through 2013.

- Despite the increases in 2004 and 2007, the annual rates for air-evacuated NBIs decreased overall from 16/1,000 person-years to 11/1,000 person-years between 2003 and 2012.
- From 2005 to 2010, the annual rates for hospitalized NBIs remained relatively constant at 6 to 8 per 1,000 person-years. However, a decrease from 2010 (6.7 per 1,000 person-years) to 2013 (1.6 per 1,000 person-years) was noted for the last 3 years of OEF.
- The annual rates for NBI deaths remained consistently less than two deaths per 1,000 person-years, showing no significant change from 2003 through 2013.



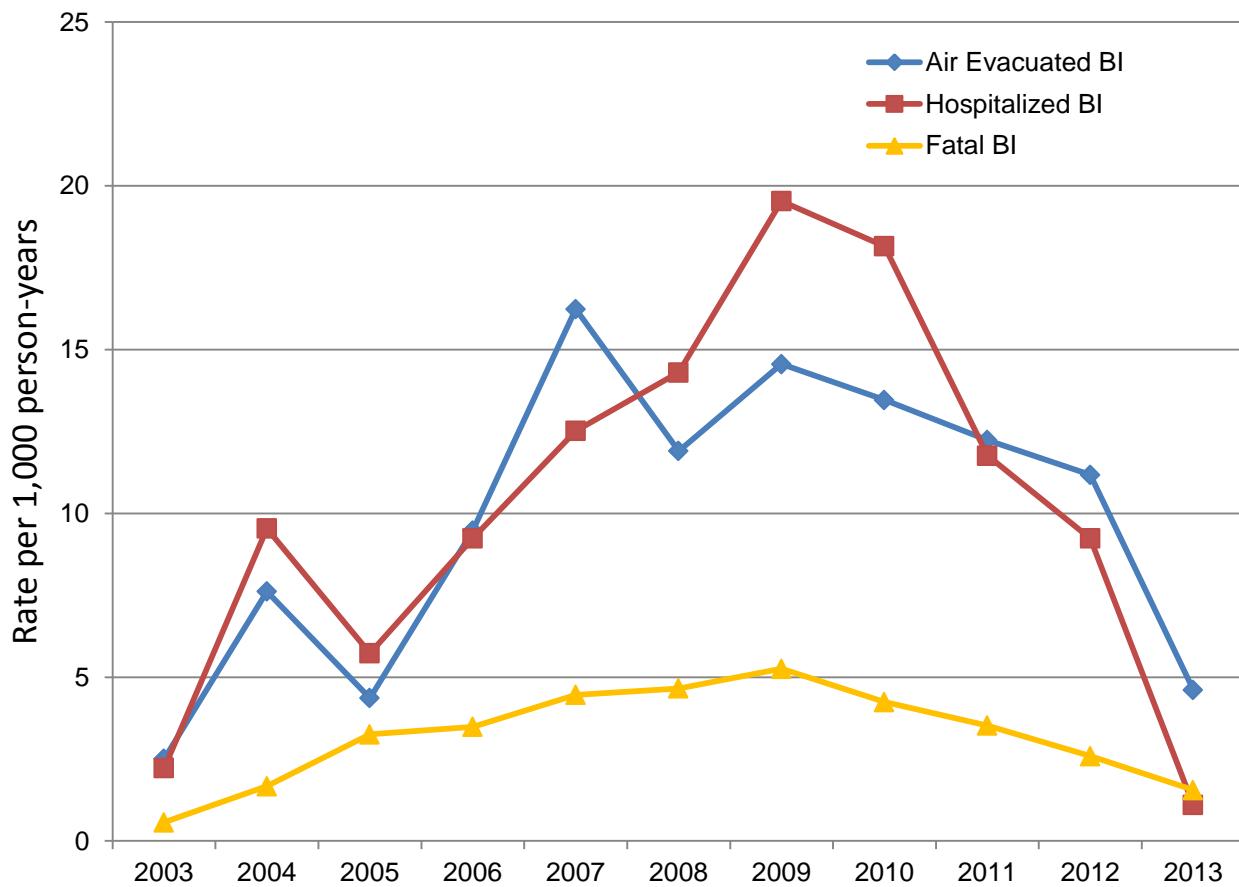
**Figure 3. Annual Rates of Air Evacuated, Hospitalized, and Fatal<sup>a</sup> Non-Battle Injuries, Operation Enduring Freedom, CY 2003–2013**

Note: Denominators for the rates were unclassified data obtained from AFHSB, Defense Health Agency.  
<sup>a</sup>2003 rate for fatal NBI is unreliable due to <20 cases for that year

## 6.5 BI Rates, Operation Enduring Freedom

Figure 4 illustrates the annual BI rates for air evacuations, hospitalizations, and deaths from 2003 to 2013.

- After BI air-evacuation rates and hospitalization rates increased through 2007 and 2009, respectively, both air-evacuation and hospitalization rates greatly decreased from 2010 to 2013.
- Annual rates for BI deaths decreased from 2010 to 2013.
- The annual rates for BI deaths had increased steadily from 2003 to 5 deaths per 1,000 person-years in 2009, before decreasing slightly to 2 deaths per 1,000 person-years in 2013.



**Figure 4. Annual Rates of Air Evacuated, Hospitalized, and Fatal<sup>a</sup> Battle Injuries, Operation Enduring Freedom, CY 2003–2013**

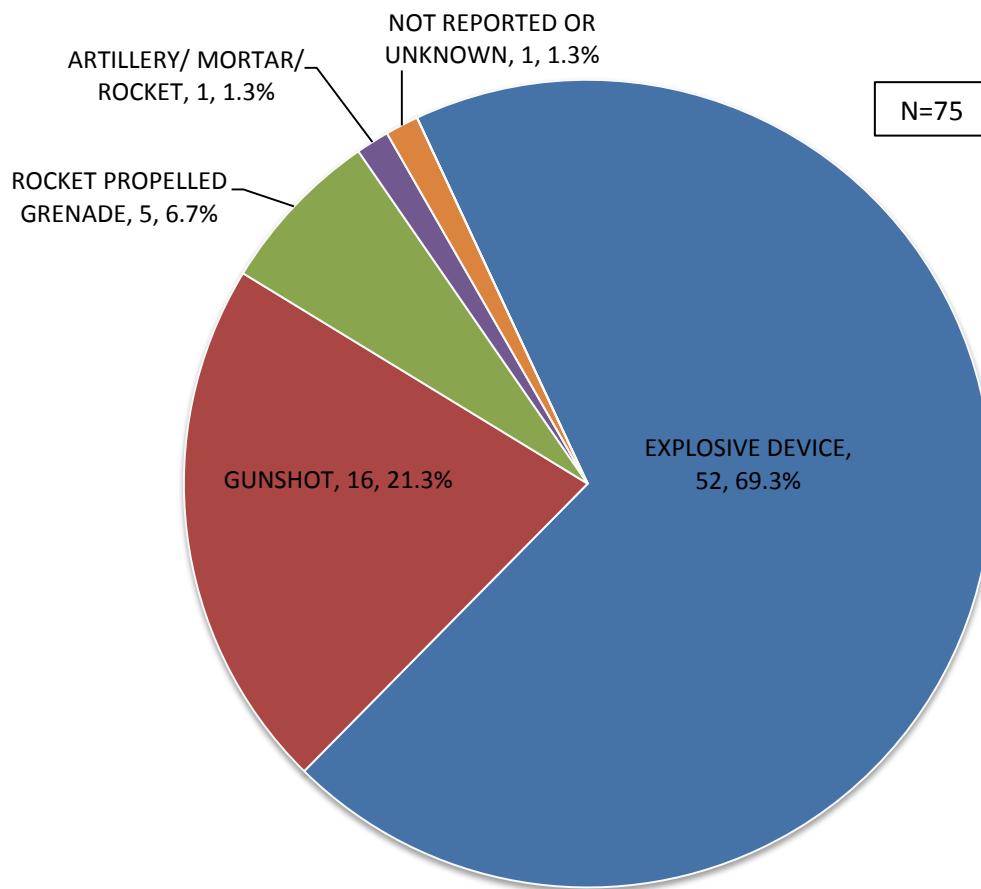
Note: Denominators for the rates were unclassified data obtained from the AFHSB, Defense Health Agency.

<sup>a</sup>2003 rate for fatal BI is unreliable due to >20 cases for that year

## 6.6 Cause of Death for Battle Injuries, Operation Enduring Freedom, CY 2013

Figure 5 illustrates the distribution of causes of Army BI deaths in CY 2013.

- Sixty-nine percent of battle fatalities were due to explosive devices.
- Twenty-one percent of battle fatalities were due to small arms fire.
- Seven percent of battle fatalities were due to rocket-propelled grenades.
- One percent of battle fatalities were due to artillery, mortar, or rockets.



**Figure 5. Distribution of Causes of Deaths by Battle Injury (n, percent) among U.S. Army Soldiers Deployed for Operation Enduring Freedom, CY 2013**

Notes: Cause category names are followed by the number of deaths for that category and the percentage of the total number of deaths. Data were obtained from Defense Casualty Information Processing System (DCIPS).

## **6.7 Injury Intent for Air Evacuations, Hospitalizations, and Deaths of Non-Battle Injuries, Operation Enduring Freedom, CY 2013**

Table 2 provides a summary of CY 2013 OEF NBIs by injury intent.

- The majority of air evacuated (93 percent) and fatal NBIs (85 percent) were unintentional injuries. Intent could not be determined from the standard inpatient data record (SIDR) for two-thirds of the hospitalized NBIs. Of the fatal NBIs, 15 percent resulted from intentionally self-inflicted injuries.
- All of the self-inflicted NBI deaths (n=4) were from weapons-related incidents.
- Of the self-inflicted NBIs resulting in air evacuation (n=11), 64 percent were caused by inhalation or ingestion of toxic substances.

**Table 2. Injury Intent for Non-Battle Injury Operation Enduring Freedom, CY 2013**

Injury Intention <sup>1</sup>	Operation Enduring Freedom					
	Air Evacuations		Hospitalizations		Deaths	
	n	%	n	%	n	%
Intentional						
Inflicted by another	6	1.0	2	2.4	0.0	0.0
Self-inflicted	11	1.8	2	2.4	4	14.8
Unintentional	565	93.4	24	29.3	23	85.2
Unknown	23	3.8	0	65.9	0.0	0.0
<b>TOTAL</b>	<b>605</b>	<b>100.0</b>	<b>84</b>	<b>100</b>	<b>27</b>	<b>100.0</b>

Note:

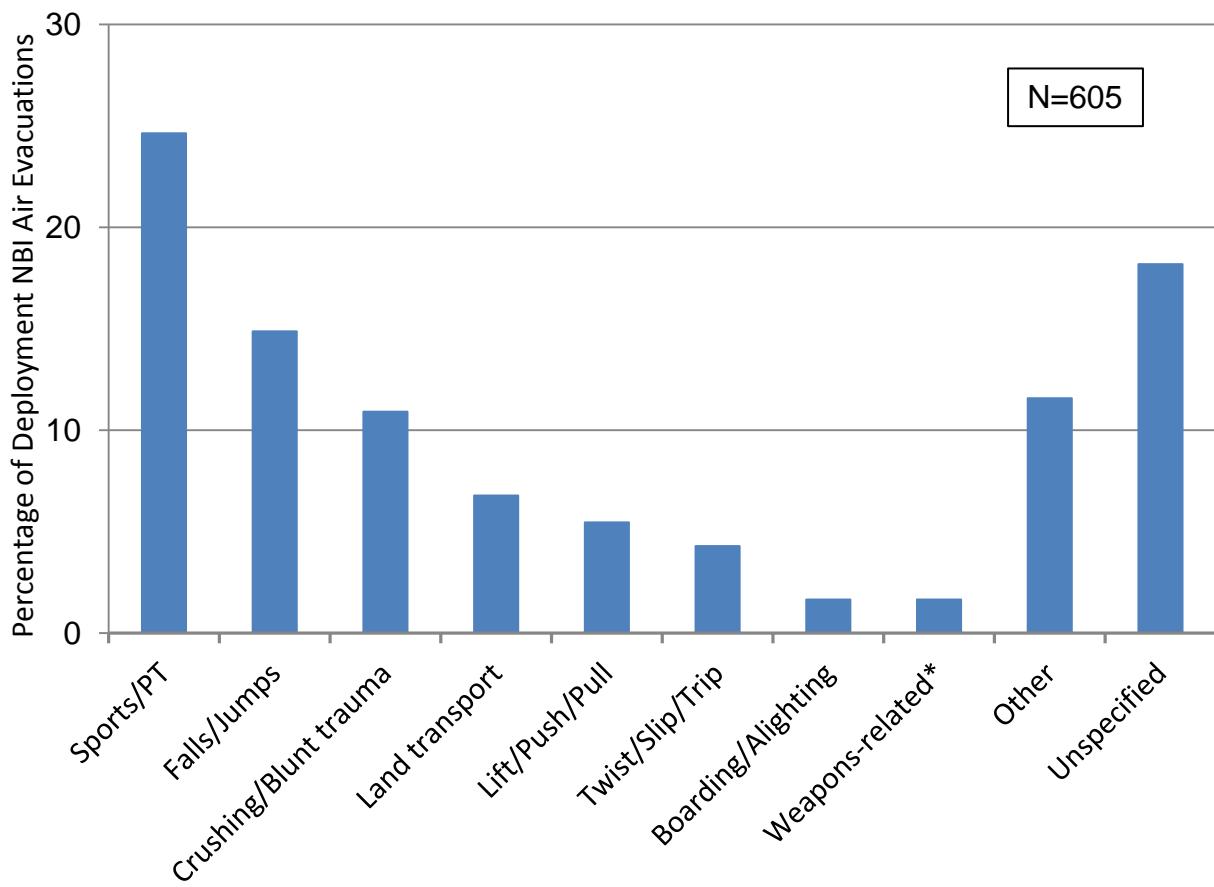
<sup>1</sup>Intention of injury was determined by the North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG) trauma code.

## **6.8 Cause of Injury for Air-Evacuated Non-Battle Injuries**

Figure 6 illustrates the distribution of the leading causes of air evacuated NBIs, categorized by the North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG) injury cause code groups.

- In 2013, the eight leading causes accounted for 86 percent (n=425/495) of the air evacuated NBIs with an identified cause of injury (n=495/605; 82%).
- The four leading causes of air-evacuated NBIs were sports/physical training, falls/jumps, crushing/blunt trauma, and land transport.

- The leading causes of sports-related NBIs were weightlifting (32%), physical training (20%), basketball (16%), and American football (10%). [Note: These data are not shown in the figure.]



**Figure 6. Distribution of Leading Causes<sup>1</sup> of Air-Evacuated Non-Battle Injury among U.S. Army Soldiers Deployed for Operation Enduring Freedom, CY 2013**

<sup>1</sup>Proportion of 2013 deployment NBI air evacuations (OEF: N=605).

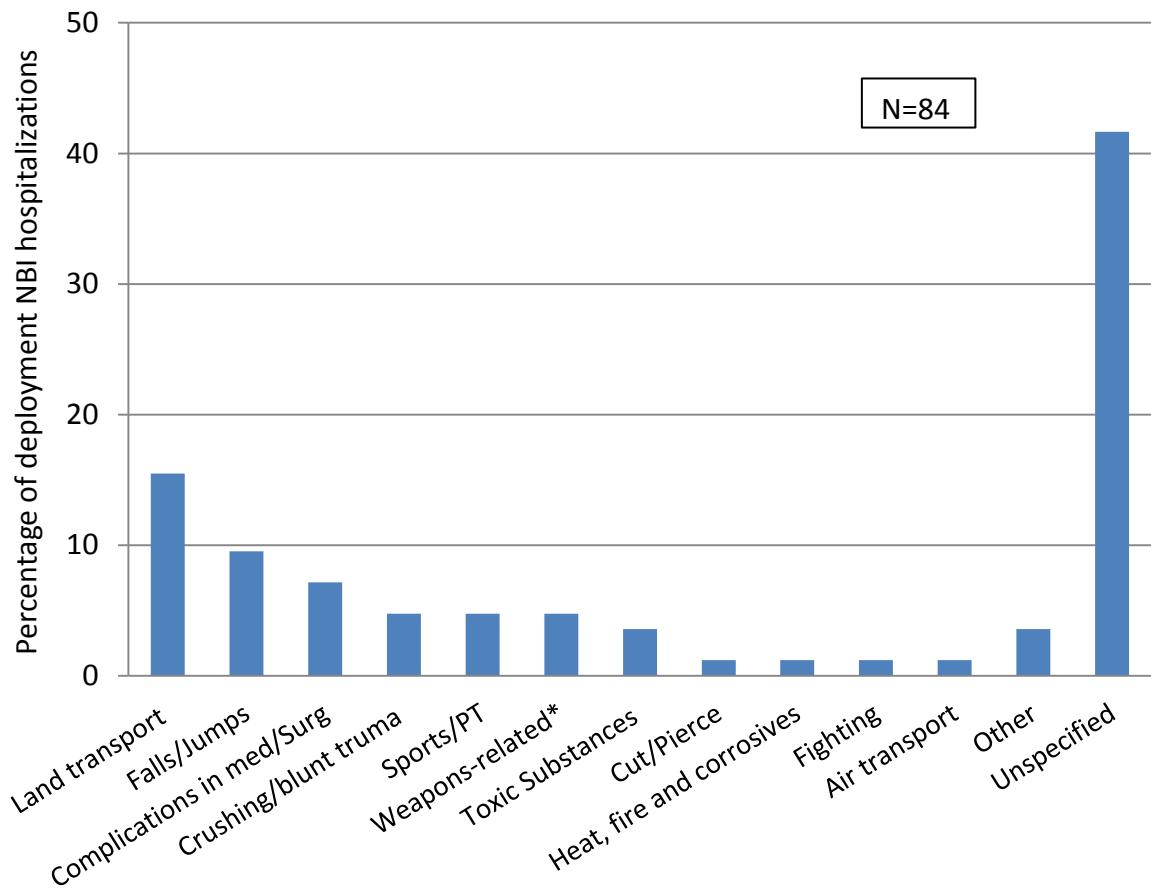
\* "Weapons-related" injuries were referred to as "own weapon" and "handling weapons/explosives" in previous reports.

## 6.9 Causes of Injury for Hospitalized Non-Battle Injuries

Figure 7 illustrates the distribution of the leading causes of injury for hospitalized NBIs, categorized by STANAG injury cause code groups.

- In 2013, the cause of injury was identified for 58 percent (49/84) of the hospitalized NBIs.

- The three leading causes of hospitalized NBIs were land transport (16%), falls/jumps (10%), and complications in medical/surgical procedures (7%).
- Fifty percent of falls/jumps were falling from one level to another (these data are not shown on the figure).



**Figure 7. Distribution of Leading Causes<sup>1</sup> of Hospitalized Non-Battle Injuries among U.S. Army Soldiers Deployed for Operation Enduring Freedom, CY 2013**

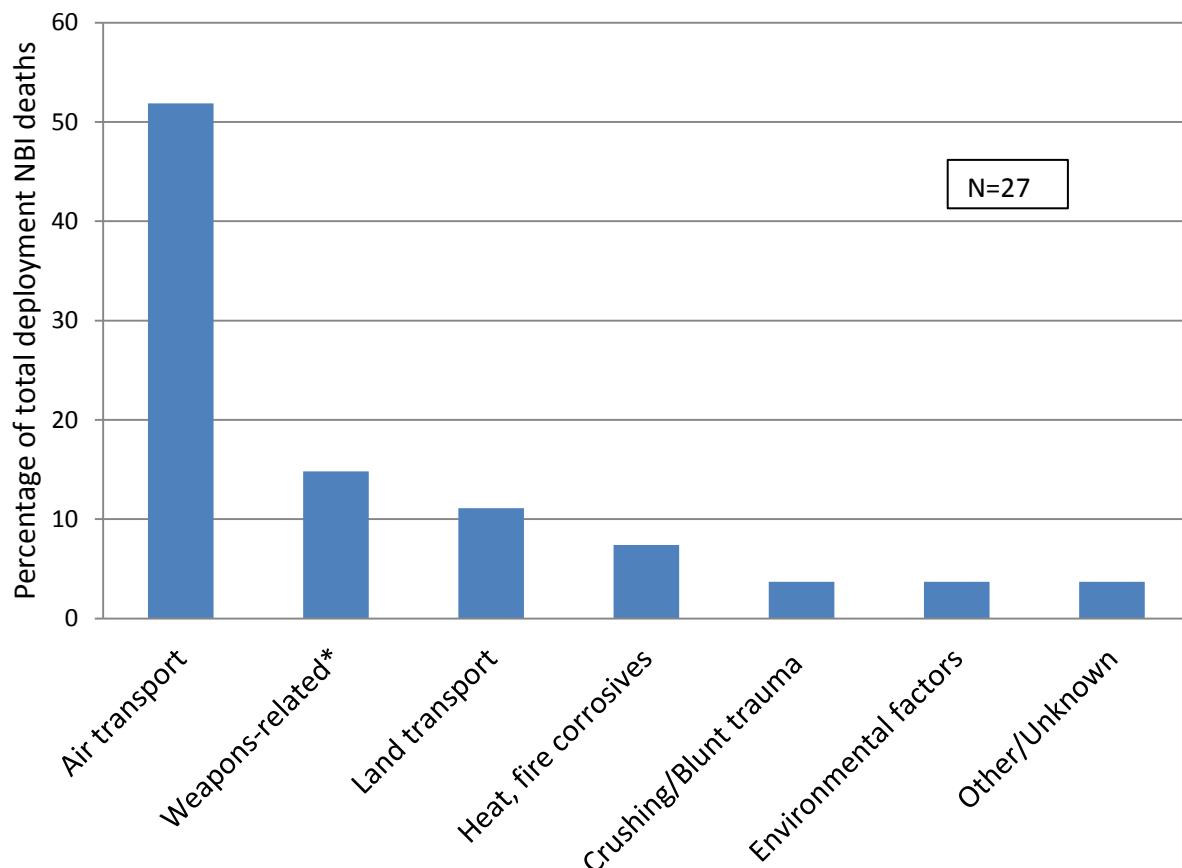
<sup>1</sup>Proportion of 2013 deployment NBI hospitalizations (OEF: N=84).

\* "Weapons-related" injuries were referred to as "own weapon" and "handling weapons/explosives" in previous reports.

## 6.10 Causes of Death by Non-Battle Injury

Figure 8 illustrates the distribution of the leading NBI causes of NBI death as a proportion of total NBI deaths.

- The leading cause of NBI death was air transport (52%).
- All “weapons-related” deaths were intentionally self-inflicted (n=4) (data not shown on the figure).
- Land transport makes up 11 percent, and heat/fire/corrosives 7 percent of the OEF NBI deaths.
- Crushing/blunt trauma and environmental factors each caused 4 percent of NBI deaths among U.S Army.



**Figure 8. Distribution of Leading Causes<sup>1</sup> of Non-Battle Injury Deaths among U.S. Army Soldiers Deployed for Operation Enduring Freedom, CY 2013**

<sup>1</sup>Cause of injury for deaths was obtained from DCIPS (OEF: N=27).

\* “Weapons-related” injuries were referred to as “own weapon” and “handling weapons/explosives” in previous reports.

### **6.11 Frequency of Air-Evacuated Traumatic Non-Battle Injuries by Injury Type and Location of Injury**

Table 3 uses a modified Barell injury matrix to categorize by injury type and body region the traumatic NBIs that were air evacuated from OEF in CY 2013.

- In 2013, 357 acute/traumatic NBIs (coded in the 800-995 ICD-9-CM code series) required medical air evacuation.
- The most common types of acute/traumatic injury leading to medical air evacuation were fractures (45%), sprains/strains (19%), and dislocations (14%).
- By body region, acute/traumatic injuries primarily involved the upper extremity (43%) and lower extremity (36%).
- The leading injuries by type and location were fractures of the wrist, hand, or fingers (15%), fractures of the lower leg and/or ankle (9%), strain/sprain of the shoulder/upper arm (8%), and dislocation of the knee (7%).

### **6.12 Frequency of Air-Evacuated Non-Battle Non-Traumatic Injuries by Type and Location of Injury**

Table 4 categorizes by type of injury and body region the NBI-related non-traumatic injuries (a subset of musculoskeletal conditions coded in the 719-739 ICD-9-CM series) that required medical air evacuation from OEF in CY 2013.

- In 2013, 189 NBI-related non-traumatic injuries required medical air evacuation.
- The most common types of air evacuated non-traumatic injuries were inflammation and pain (overuse) (53%), sprain/strain/rupture of muscle or tendons (21%), joint derangement (11%), and joint derangement with neurological involvement (11%).
- At 48 percent, the spine/back was the body region most affected by non-traumatic injuries, followed by the lower extremities (23%), and upper extremities (23%).
- The leading specific non-traumatic injuries were inflammation and pain (overuse) in the lower back (lumbar spine) (27%), sprain/strain/rupture in the shoulder (9%), inflammation and pain (overuse) in the shoulder (8%), and sprain/strain/rupture in the lower leg, knee (8%).

### **6.13 Frequency of Hospitalized Traumatic Non-Battle Injuries by Type and Location of Injury**

Table 5 uses the modified Barrel injury matrix to categorize by type of injury and body region the traumatic NBIs that required in-theater hospitalization in OEF in CY 2013.

- In 2013, 46 traumatic NBIs (coded in the 800-995 ICD-9-CM code series) required in-theater hospitalization.

- The most common types of injury leading to in-theater hospitalization were fractures (48%), open wound (9%), contusion/superficial injury (9%), and system-wide and late effects (9%).
- These injuries most often affected the head/face/neck excluding TBI (28%), lower extremity (24%), and upper extremity (17%).
- The most common hospitalized traumatic NBIs were fracture of the face (15%), fractures of the lower leg and/or ankle (11%), and system wide and late effects (9%).

#### **6.14 Frequency of Hospitalized Non-Battle Non-Traumatic Injuries by Type and Location of Injury**

Table 6 categorizes by type of injury and body region the hospitalized NBI-related non-traumatic injuries (a subset of musculoskeletal conditions coded in the 719-739 ICD-9-CM series) in CY 2013.

- In 2013, 6 NBI-related non-traumatic injuries required in-theater hospitalization.
- The most common types of hospitalized non-traumatic injuries were inflammation and pain (overuse) (83%) and joint derangement with neurological involvement (17%).
- At 67 percent, the spine/back was the body region most affected by non-traumatic injuries, followed by the lower extremity (17%), and upper extremity (17%).

**Table 3. Frequency of Air-Evacuated Traumatic Non-Battle Injuries by Type and Location of Injury, U.S. Army, Operation Enduring Freedom, CY 2013**

		Fracture	Dislocation	Sprains/Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/Superficial	Crush	Burns	Nerves	Unspecified	System-wide & late effects	Post-Concussive	Total	Percent	Percent by Body Region	
Head and Neck	Traumatic Brain Injury (TBI)	Type 1 TBI	0		9						0					9	2.5	4.8	
		Type 2 TBI	3		3											6	1.7		
		Type 3 TBI	0													0	0.0		
		Additional DVbic codes											2	0	0	2	0.6		
Other Head, Face, Neck	Other head				1						0	0				1	0.3	2.8	
	Face	7	0	0	0						0					7	2.0		
	Eye				1				0		0	0				1	0.3		
	Neck	0		0	0					0	0	0				0	0.0		
	Head, Face, Neck Unspec.								0	0	1	0	0			1	0.3		
Spine and Back	Spinal Cord (SCI)	Cervical SCI	0		0											0	0.0	0.6	
		Thoracic/Dorsal SCI	0		0											0	0.0		
		Lumbar SCI	1		1											2	0.6		
		Sacrum Coccyx SCI	0		0											0	0.0		
		Spine, Back Unspec. SCI	0		0											0	0.0		
Vertebral Column (VCI)	Vertebral Column (VCI)	Cervical VCI	2	0	0											2	0.6	2.8	
		Thoracic/Dorsal VCI	2	0	0											2	0.6		
		Lumbar VCI	1	0	3											4	1.1		
		Sacrum Coccyx VCI	1	0	0											1	0.3		
		Spine, Back Unspec. VCI	1	0	0											1	0.3		
Torso	Torso	Chest (thorax)	3	0	0	2	0		0	0	0	0				5	1.4	4.5	
		Abdomen			3	1		1	0		0	0				5	1.4		
		Pelvis, Urogenital	2	0	0	1	0		0	0	0	0				3	0.8		
		Trunk	0			0			0	0	1	0	1			2	0.6		
		Back, Buttock			1		0		0	0	0					1	0.3		
Extremities	Upper	Shoulder, Upper Arm	5	15	28	0	0		1	0	0	0		0		49	13.7	42.9	
		Forearm, Elbow	19	1	0	1	0		0	0	0					21	5.9		
		Wrist, Hand, Fingers	54	2	2	8	5		1	1	1		5			79	22.1		
		Other & Unspec.	0			0	0	1	0	0	0	2	1			4	1.1		
	Lower	Hip	1	1	3				0	0						5	1.4	35.9	
		Upper leg, Thigh	2				0		0	0	1					3	0.8		
		Knee	6	24	9				0	0	0					39	10.9		
Unclass. by Site	Other, Unspecified	Lower leg, Ankle	32	0	12		0		0	0	0					44	12.3	3.1	
		Foot, toes	14	5	2	2	0		2	1	0					26	7.3		
		Other & Unspec.	1		6	2	0	0	0	1	1	0				11	3.1		
	System-wide & late effects	Other/Multiple	0				0			0	1					1	0.3	3.1	
		Unspec. Site	4	1	3	0	0	0	0	0	1	0	1			10	2.8		
		Total	161	49	69	19	16	5	2	4	3	6	3	10	10	0	357	100%	
		Percent	45.1	13.7	19.3	5.3	4.5	1.4	0.6	1.1	0.8	1.7	0.8	2.8	2.8	0.0		100%	

Note: ICD-9-CM 800-995 codes. Includes the first listed injury diagnosis for injuries resulting in out-of-CENTCOM air evacuation.

**Table 4. Frequency of Air-Evacuated Non-Battle Non-Traumatic Injuries by Type and Location of Injury, U.S. Army, Operation Enduring Freedom, CY 2013**

		Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological	Stress Fracture	Sprains/Strains/Rupture	Dislocation	Total	Percent	Percent by Body Region	
Spine and Back	Vertebral Column (VCI)	Cervical VCI	10	1	8			19	10.1	48.1	
		Thoracic/Dorsal VCI	0	3				3	1.6		
		Lumbar VCI	51	3	8			62	32.8		
		Sacrum Coccyx VCI	0					0	0.0		
		Spine, Back Unspec. VCI	5	1	1	0		7	3.7		
Extremities	Upper	Shoulder	16	3		17	1	37	19.6	23.3	
		Upper Arm, Elbow	1	0	0		0	1	0.5		
		Forearm, Wrist	2	0	0		1	3	1.6		
		Hand	0	1		2	0	3	1.6		
	Lower	Pelvis, Hip, Thigh	1	1	0	1	0	3	1.6	23.3	
		Lower leg, Knee	8	11	2	16	0	37	19.6		
		Ankle, Foot	4	0	0	0	0	4	2.1		
Unclass. by Site	Other, Unspecified	Other specified/Multiple	1	0	0	0	0	1	0.5	5.3	
		Unspecified Site	1	0	1	3	4	9	4.8		
		Total	100	21	21	5	40	2	189	100.0	
		Percent	52.9	11.1	11.1	2.6	21.2	1.1			

Note: ICD-9-CM 710-739 codes. Includes the first listed injury diagnosis for injuries resulting in out-of-CENTCOM air evacuation.

**Table 5. Frequency of Hospitalized Traumatic Non-Battle Injuries by Type and Location of Injury, U.S. Army, Operation Enduring Freedom, CY 2013**

		Fracture	Disloca-tion	Sprains/Strains	Internal	Open Wound	Amputa-tions	Blood Vessel	Contu-sion/Superficial	Crush	Burns	Nerves	Unspec-i-fied	System-wide & late effects	Post-Concussive	Total	Percent	Percent by Body Region
Head and Neck	Traumatic Brain Injury (TBI)	Type 1 TBI	1		0							0				1	2.2	4.3
		Type 2 TBI	0		1											1	2.2	
		Type 3 TBI	0													0	0.0	
	Additional DVbic codes															0	0.0	
	Other head															1	2.2	
Other Head, Face, Neck	Face		7	0	0	0					0	0				7	15.2	28.3
	Eye					1			0		0	0				1	2.2	
	Neck		0		0	0				0	0	0				0	0.0	
	Head, Face, Neck Unspec.															4	8.7	
	Head, Face, Neck Unspec.															1	2.2	
Spine and Back	Spinal Cord (SCI)	Cervical SCI	0		0											0	0.0	0.0
		Thoracic/Dorsal SCI	0		0											0	0.0	
		Lumbar SCI	0		0											0	0.0	
		Sacrum Coccyx SCI	0		0											0	0.0	
		Spine, Back Unspec. SCI	0		0											0	0.0	0.0
Spine and Back	Vertebral Column (VCI)	Cervical VCI	1	0	0											1	2.2	4.3
		Thoracic/Dorsal VCI	1	0	0											1	2.2	
		Lumbar VCI	0	0	0											0	0.0	
		Sacrum Coccyx VCI	0	0	0											0	0.0	
		Spine, Back Unspec. VCI	0	0												0	0.0	0.0
Torso	Torso	Chest (thorax)	1	1	0	0	0	0	0	0	1	0	0			3	6.5	10.9
		Abdomen			1	0	0	0	0	0	1	0				2	4.3	
		Pelvis, Urogenital	0	0	0	0	0	0	0	0	0	0				0	0.0	
		Trunk	0			0			0	0	0	0	0			0	0.0	
		Back, Buttock			0	0			0	0	0					0	0.0	0.0
Extremities	Upper	Shoulder, Upper Arm	1	0	0	0	0	0	0	0	0	0	0			1	2.2	17.4
		Forearm, Elbow	2	1	0	0	0	0	0	0	0	0	0			3	6.5	
		Wrist, Hand, Fingers	2	0	0	2	0	0	0	0	0	0	0			4	8.7	
		Other & Unspec.	0			0	0	0	0	0	0	0	0			0	0.0	
	Lower	Hip	0	0	0				0	0						0	0.0	23.9
		Upper leg, Thigh	0			0			0	0	1					1	2.2	
Unclass. by Site	Knee		0	0	0				0	0	0					0	0.0	2.2
	Lower leg, Ankle		5	0	0		0		0	0	0					5	10.9	
	Foot, toes		1	0	0	0	0	0	1	0	0					2	4.3	
	Other & Unspec.		0		0	0	0	0	1	0	1		1			3	6.5	
	System-wide & late effects													4	4	8.7	100%	
		Total	22	2	1	2	4	0	0	4	2	3	0	2	4	0	46	
		Percent	47.8	4.3	2.2	4.3	8.7	0.0	0.0	8.7	4.3	6.5	0.0	4.3	8.7	0.0	100%	

Note: ICD-9-CM 800-995 codes. Includes the first listed injury diagnosis for hospitalized NBIs in CENTCOM.

**Table 6. Frequency of Hospitalized Non-Battle Non-Traumatic Injuries by Type and Location of Injury, U.S. Army, Operation Enduring Freedom, CY 2013**

		Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological	Stress Fracture	Sprains/Strains/Rupture	Dislocation	Total	Percent	Percent by Body Region	
Spine and Back	Vertebral Column (VCI)	Cervical VCI	0	0	0			0	0.0	66.7	
		Thoracic/Dorsal VCI	0	0				0	0.0		
		Lumbar VCI	1	0	1			2	33.3		
		Sacrum Coccyx VCI	0					0	0.0		
		Spine, Back Unspec. VCI	2	0	0	0		2	33.3		
Extremities	Upper	Shoulder	0	0		0	0	0	0.0	0.0	
		Upper Arm, Elbow	0	0	0		0	0	0.0		
		Forearm, Wrist	0	0	0		0	0	0.0		
		Hand	0	0		0	0	0	0.0		
	Lower	Pelvis, Hip, Thigh	1	0	0	0	0	1	16.7	16.7	
		Lower leg, Knee	0	0	0	0	0	0	0.0		
		Ankle, Foot	0	0	0	0	0	0	0.0		
Unclass. by Site	Other, Unspecified	Other specified/Multiple	0	0	0	0	0	0	0.0	16.7	
		Unspecified Site	1	0	0	0	0	1	16.7		
		Total	5	0	1	0	0	6	100.0	100.0	
		Percent	83.3	0.0	16.7	0.0	0.0				

Note: ICD-9-CM 710-739 codes. Includes the first listed injury diagnosis for injuries resulting in in-CENTCOM hospitalization.

## **7 Discussion and Recommendations**

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### **7.1 Discussion**

In CY 2013, non-battle injury (NBI) was the largest single diagnosis category that resulted in out-of-CENTCOM air evacuations and hospitalizations for Operation Enduring Freedom (OEF). Battle injury (BI) is the third leading cause in air evacuations and second leading in hospitalizations. The present findings are consistent with previous reports showing the relative importance of NBIs as a cause of morbidity and mortality (references 1-10).

- In the CY 2012 deployment injury surveillance report for OEF, there were nearly three times more air-evacuated disease and NBIs (NBI: n=885; Disease: n=1,478) combined, than BIs (n=760). If we look at NBIs alone, they comprised 28 percent of air evacuations, higher than BIs (24%) (reference 14).
- In 2013 for OEF, there were six times as many air-evacuated DNBIs (NBI: n=605; Disease: n=866) than BIs (n=243), and 34% of air evacuations were NBIs.
- For hospitalizations, the proportion of NBIs has increased and the proportion of BIs decreased from 2012 in OEF (reference 15).

For both BI and NBI, OEF has experienced greater fluctuations in the rates of air evacuations and hospitalizations than deaths from 2003-2013. Injury rates and trends for OEF were previously reported by other descriptive studies (references 16-17). However, unlike Figures 3 and 4, these studies did not include the 2007 time period when considering peak rates throughout the years.

- In OEF, the NBI rates decreased for air evacuations, hospitalizations, and deaths in 2013 compared to 2012. Battle injury hospitalizations had the biggest differential decrease going from 9.2 to 1.1 per 1,000 person-years. Air-evacuated NBIs decreased from 13.0 to 11.5 per 1,000 person-years.
- From 2012 to 2013, BI rates decreased in OEF from 2.6 to 1.4 per 1,000 person-years. Even though there was this overall decrease in the rate, the leading causes of OEF battle-related deaths remained similar to previous years. However, an increase was noted in the proportion of BI deaths caused by explosive devices from 59 percent to 69 percent and rocket propelled grenade from 4 percent to 7 percent.

In this report for OEF, the leading types of traumatic air-evacuated NBIs were fracture (n=161; 45%), sprain/strain (n=69; 19%), and dislocation (n=49; 14%). The leading type of NBI-related non-traumatic injury was pain and inflammation (overuse) (n=100; 53%). These leading injury types have been consistent for several years (references 5 and 8-10). The finding of fractures as the leading NBI types for both hospitalizations and air evacuations was consistent with the burden of non-battle orthopedic injuries treated at one facility during the combat phase of OIF (reference 18).

In general, previous studies have focused on specific body regions or diagnosis categories when describing injury or disease types during these operations. This investigation described all body regions affected for each injury type.

- Whereas the upper extremity and lower extremity account for most of the traumatic air-evacuated NBIs (43 and 36%, respectively), the spine and back account for the majority of air-evacuated NBI-related non-traumatic injuries (48%).
- The leading body sites for injury slightly differ in 2013 compared to 2012. In 2012, the leading body injury sites for hospitalized NBIs, in order from high to low, were the wrist/hand/fingers, lower leg/ ankle, and system-wide/late effects. But in 2013, the leading body injury sites were face, lower leg/ankle, and wrist/hand/fingers.
- Like the air-evacuated NBI-related non-traumatic injuries, the spine and back (67%) accounted for the majority of hospitalized NBI-related non-traumatic injuries.

The U.S. Army uses surveillance data to identify causes of injury and potentially modifiable risk factors for injury to develop comprehensive injury prevention programs. This report has identified the top three causes of air-evacuated NBI in 2013 as sports/physical training, falls/jumps, and crushing/blunt trauma. The top three leading causes of hospitalized NBI were land transport-related accidents, falls/jumps, and complications in medical/surgical procedures. The three leading causes of fatal NBIs were air transport-related accidents, weapons-related incidents (gunshot wounds), and land transport-related accidents. Self-inflicted injury rates increased from 2004 to 2008 (reference 19) and accounted for 15 percent of fatal NBIs. All of these self-inflicted deaths were weapons-related.

- When comparing the leading causes of OEF NBIs from 2012 to 2013, they show similar results. Air-evacuated sports/physical training injuries (25%) stayed as the first leading cause. Hospitalized fall/jump injuries (10%) went to second leading cause from first leading. The leading cause of fatal NBI in 2012 also went from first to second leading in 2013, weapons-related incidents (15%). The number of weapons-related death in OEF decreased from 62 to 15 from 2012 to 2013.
- In 2012, there were 4 deaths caused by aircraft crashes; however there were 14 fatalities in 2013.

Current intervention studies and strategies (Civilian and military) to address deployment NBI include—

- Vehicle rollover drowning prevention training, rollover simulator training, equipment modifications to prevent rollover accidents, and improved compliance for seatbelt use (references 20-22).
- Boarding and alighting of land and air-transport training to reduce fall and jump injuries.
- Ocular preventive measures such as hygiene, contact lens restriction, and protective eyewear use during participation in racquet and contact sports (references 23-26).
- Use of ankle braces (stabilizers) to reduce ankle injuries (references 27-29).
- Breakaway bases, recessed bases, and proper sliding technique education for softball and baseball sliding injuries (reference 30).
- Mouth guard use in sports activities where there is significant risk of orofacial injury (references 31-32).

## 7.2 Recommendations

- Continue routine surveillance of deployment injuries and annual updates of this deployment injury-surveillance report.
- Link additional data sources, such as levels IV and V hospitalizations and disability records, to provide an enhanced description of deployment injuries and their outcomes.
- Continue investigations to identify potentially modifiable risk factors that contribute to the leading causes of injury.
- Focus attention on strategies that will aid in preventing injuries from sports/physical training, falls/jumps, and land transport accidents.
  - Make sure surfaces for sports are level and free of hazards.
  - Avoid overtraining.
  - Be cautious when getting on and off vehicles and working around them to avoid falls.
  - Wear seatbelts when tactical situation permits.

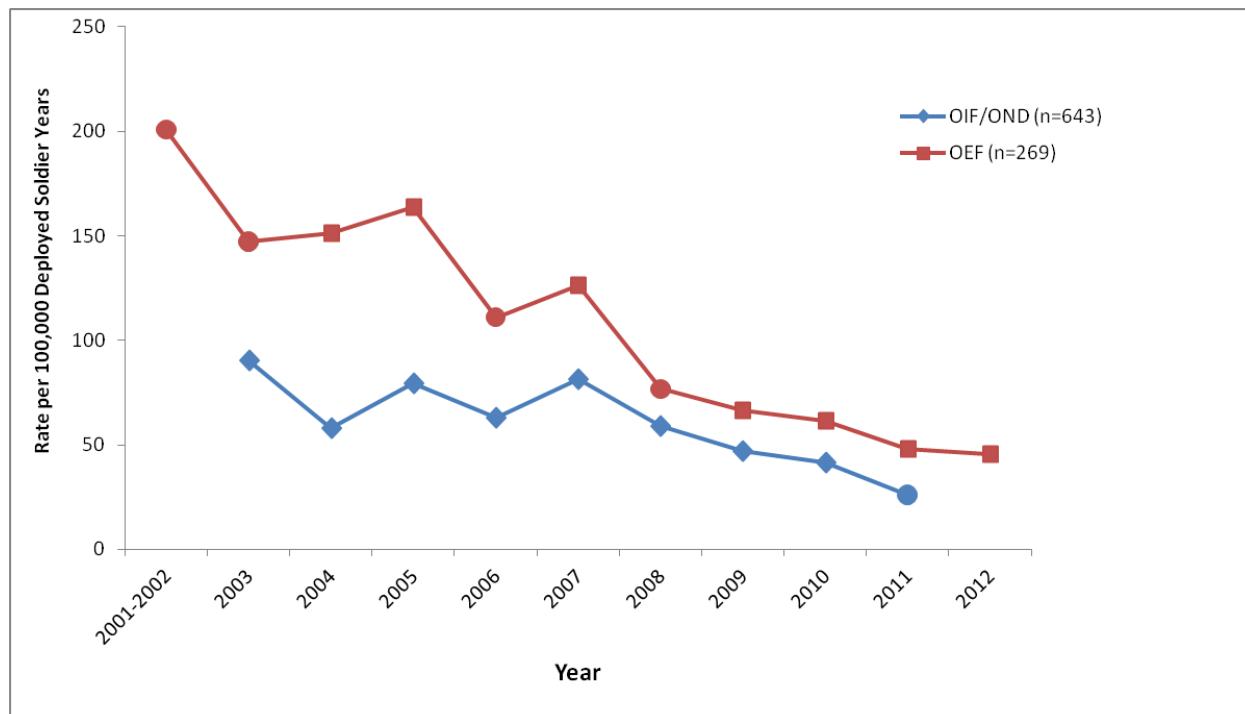
## 8 Results—Special Analytic Deployment Injury Surveillance Project Summaries, 2013

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### 8.1 Surveillance of Causes of Fatal Non-Battle Injuries among Army Soldiers Deployed for Operation Enduring Freedom (Afghanistan) and Operation Iraqi Freedom/Operation New Dawn (Iraq), 2001-2012 (Poster—American Public Health Association 2013 conference)

From 2001-2012, there were 4,876 fatalities among Army Soldiers deployed for OIF/OND and OEF. Among these fatalities, 79% (n=3,839) were battle injuries (BIs), 18% (n=902) were non-battle injuries (NBIs), and 3% (n=125) were due to illness/disease. Non-battle injuries were a significant cause of mortality among troops deployed in support of OIF/OND and OEF between 2001 and 2012.

The annual rates for OIF/OND and OEF are calculated as the number of fatalities per 100,000 deployed Soldier-years (Figure 9). Overall, Soldiers deployed to OIF/OND were 8 percent less likely to sustain a fatal NBI as compared to Soldiers deployed to OEF (OIF/OND: 65 per 100,000 Soldier-years; OEF: 76 per 100,000 Soldier-years; p=.03). For both operations, there was a downward trend in the rates over time. After 2007, OEF rates approached OIF/OND rates more closely than in previous years



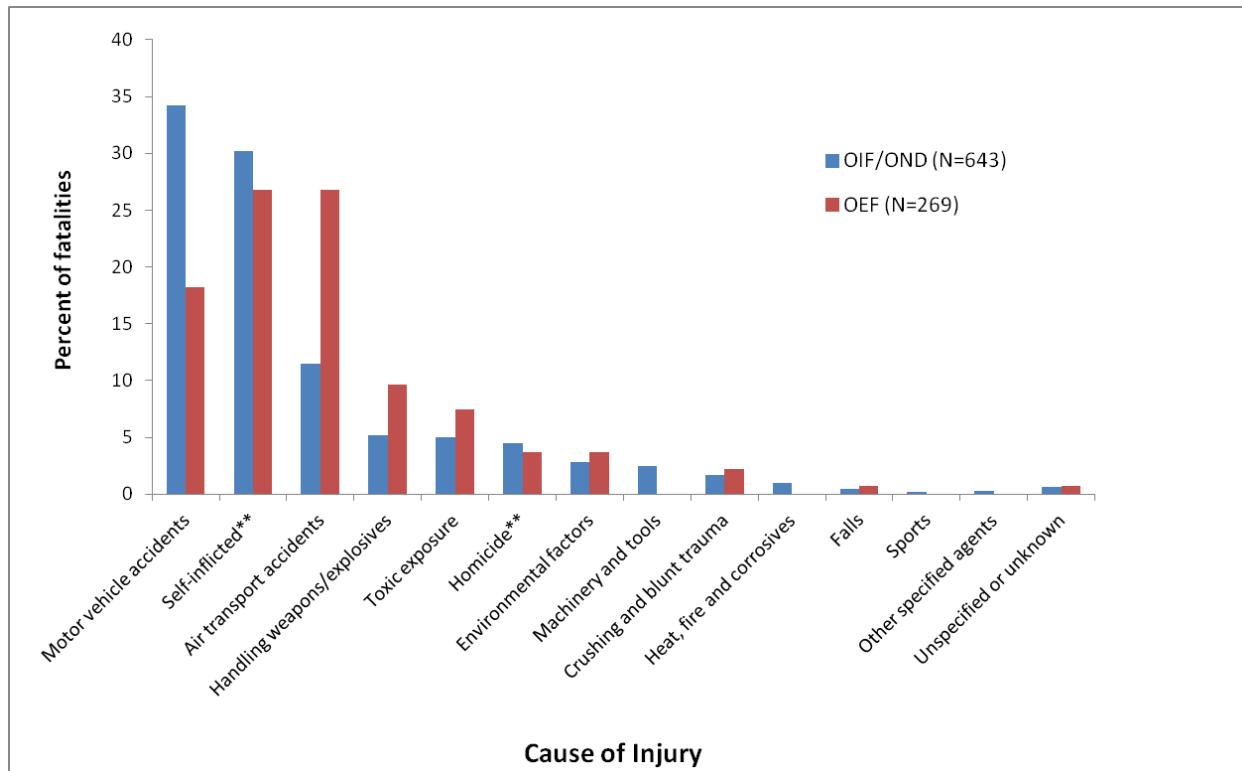
**Figure 9. Annual Rate of All Fatal Non-Battle Injuries by Operation, U.S. Army, 2001-2012**

Note: Annual rates derived from fatality counts less than 20 are considered unstable and, therefore, should be used with caution.

- Indicates that the annual rate for OIF/OND is based on fewer than 20 fatalities.
- Indicates that the annual rate for OEF is based on fewer than 20 fatalities.

Causes of fatal NBIs are shown graphically in Figure 10. Leading causes of fatal NBIs included: motor vehicle accidents (OIF/OND: 34%; OEF: 18%); air transport accidents (OIF/OND: 12%; OEF: 27%); unintentional, handling weapons/explosives (OIF/OND: 5%; OEF: 10%) and intentional, self-inflicted (OIF/OND: 30%; OEF: 27%).

The distribution of the leading causes differed between the two operations. There were significant differences in proportions between OIF/OND and OEF for motor vehicle accidents ( $p<.001$ ), air transport accidents ( $p<.001$ ) and handling weapons/explosives ( $p=.02$ ).



**Figure 10. Causes of Fatal Non-Battle Injuries for Operation Iraqi Freedom/Operation New Dawn and Operation Enduring Freedom, US Army, 2001-2012**

Note: Causes of Injury are ordered highest to lowest based on OIF/OND.

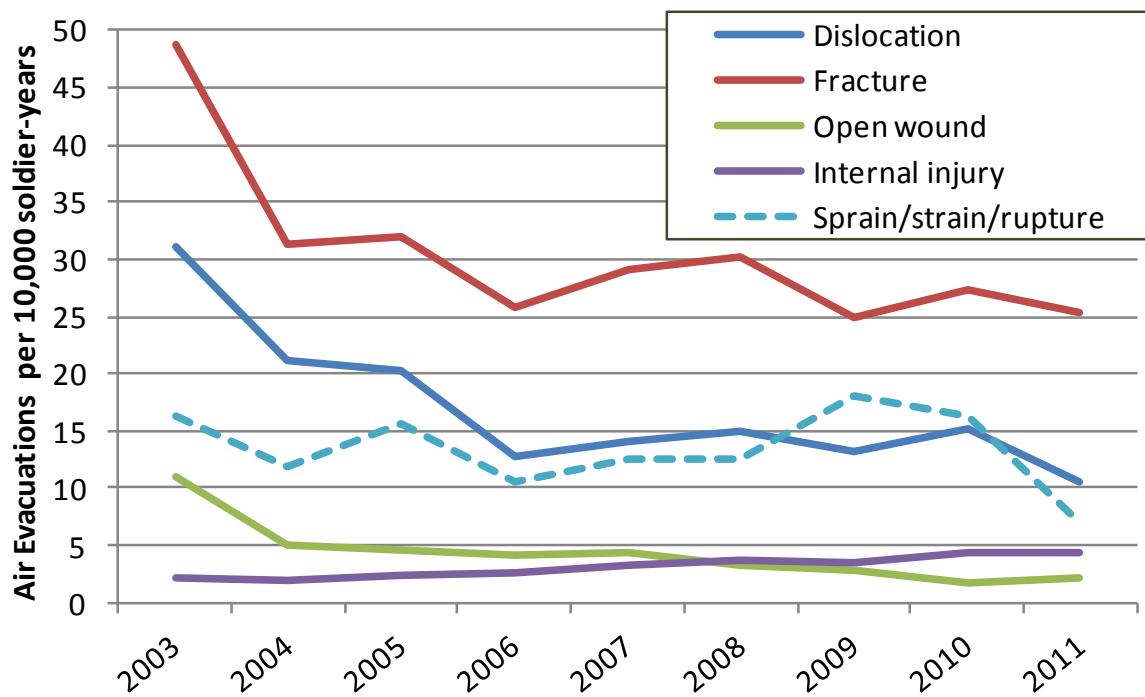
\*\*Intentional Injuries

## 8.2 Public Health Surveillance of Trends in Non-Battle Injury Rates among Army Soldiers Deployed to Iraq and Afghanistan, 2001-2012 (Oral Presentation - American Public Health Association 2013 conference)

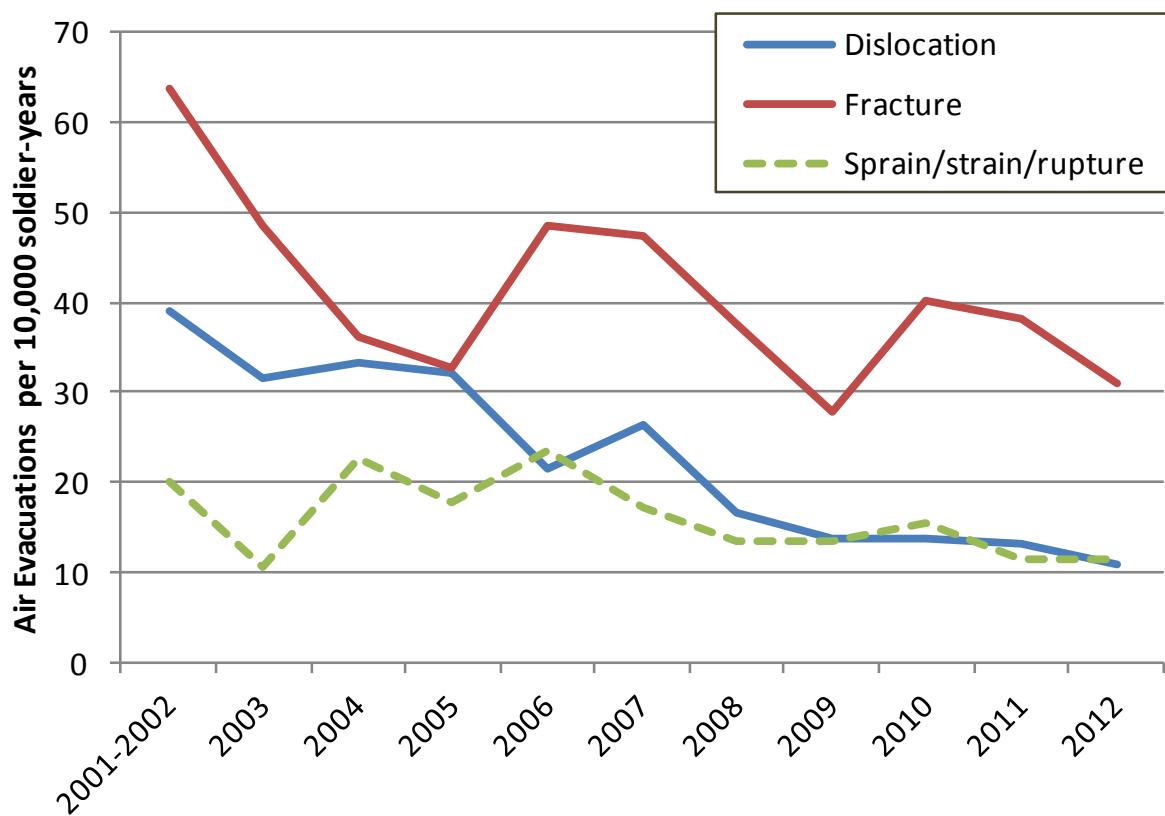
The APHC maintains a surveillance system for NBIs of Soldiers who have been deployed for OIF and OEF.

From 2001 through 2011, 15,946 (OIF/OND) and 4,382 (OEF) NBIs were air evacuated from theater. Fracture, dislocation, open wound, and crush NBI rates decreased over time ( $p<.05$ ) (Figures 11 and 12). Decreases in these NBI rates were related to decreases in the rates for motor vehicle accident, crush/blunt trauma, fall/jump, slip/trip, and cut/pierce injuries ( $p<.05$ ). The only

NBI rate to increase over time was internal injury. Injury rates for the upper and lower extremity, torso, and head/face/neck decreased ( $p<.05$ ). These decreases in the lower extremity NBI rates were related to decreases in fall/jump and slip/trip NBI rates ( $p<.05$ ).



**Figure 11. Types of Non-Battle Injuries Annual Rates for Iraq 2003-2011**



**Figure 12. Types of Non-Battle Injury Annual Rates for Afghanistan 2001-2012**

## **9 Conclusions and Recommendations for Commanders**

### **9.1 Conclusions**

Significant differences between operations were seen for the percent of non-battle injury (NBI) fatalities caused by motor vehicle accidents, air transport accidents, and handling weapons/explosives. Many of these injuries are potentially preventable and could be targeted for intervention. Additional research is needed to better understand the factors contributing to fatal NBIs and the differences between operations.

Maintaining a public health surveillance database and examining NBI trends over time provides important information for identifying intervention needs to maintain Army Soldier health and readiness even in deployed situations.

## 9.2 Recommendations

Use evidence-based countermeasures and safety guidelines to lower the injury risk (reference 33).

Leaders and Soldiers should use composite risk management to identify hazards and control risks across all Army missions and activities.

Report timely and accurate accident histories to promote the ability to monitor and identify injury risk factors, incidence and causes.

Focus attention of strategies that will aid in preventing injuries from leading causes of injury.

- To prevent sports and physical training injuries—

- Avoid training too hard or too long when beginning or changing activities.
  - Gradually increase how often and how long you train after a break in training due to leave, illness, or redeployment.
  - Use protective equipment (e.g., mouth guards, ankle braces, break-away bases) and promote adherence to game/sport rules

- To prevent motor-vehicle related injuries—

- Use ground guides to ensure vehicles are not traveling too fast for high risk or heavily populated areas. Train all personnel when to use ground guides and how to execute ground-guiding procedures.
  - Secure personnel and cargo—seat belts and gunner restraints save lives and prevent injury.
  - Rehearse rollover, emergency egress, and rescue drills prior to each mission.
  - Establish and enforce safe speed limits for the road and environment.

- To prevent fall-related injuries—

- Inspect the facilities on the operating base to identify and remove hazards that may lead to slips, trips, and falls indoors and outdoors.
  - Remove trip hazards from sidelines of basketball courts and sport fields.
  - When feasible, ensure personnel use fall protection when working at heights.
  - Conduct spot checks to ensure appropriate guards and barriers are in place.

## **10 Point of Contact**

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The point of contact at the Army Public Health Center is the Clinical Public Health and Epidemiology Directorate, Injury Prevention Division, commercial 410-436-4655 or DSN 584-4655. Inquiries may also be submitted electronically at [usarmy.apg.medcom-phc.mbx.injuryprevention@mail.mil](mailto:usarmy.apg.medcom-phc.mbx.injuryprevention@mail.mil). Specific questions may be directed to author(s) listed at the front of this report.

Approved:

DR. BRUCE H. JONES  
Director  
Injury Prevention Division

## Appendix A

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**Appendix B**

**Barell Injury Diagnosis Matrix and Associated ICD-9-cm 800-995 Codes**

Public Health Report No. S.0047240-16

## Appendix C

### Injury-Related Musculoskeletal Condition Matrix and Associated ICD-9-CM 710-739 Codes

Injury Location		Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological Involvement	Stress Fracture	Sprains/Strains/Rupture	Dislocation
Vertebral Column	Cervical	723.1	722.0	722.71, 723.4			
	Thoracic/Dorsal		722.11	722.72, 724.4			
	Lumbar	724.2	722.10	722.73, 724.3			
	Sacrum, Coccyx	720.2					
	Spine, Back Unspecified	721.7, 724.5	722.2	722.70, 724.9	733.13		
Extremities	Upper	Shoulder	716.11, 719.(01.,11.,41), 726(0.,1.,2)	718(01.,11.,81.,91)		727(.61-.62)	718.31
		Upper arm, Elbow	716.12, 719.(02.,12.,42), 726.3	718(02.,12.,82.,92)	733.11		718.32
		Forearm, Wrist	716.13, 719.(03.,13.,43), 726.4	718(03.,13.,83.,93)	733.12		718.33
		Hand	716.14, 719.(04.,14.,44)	718(04.,14.,84.,94)		727(.63-.64)	718.34
	Lower	Pelvis, Hip, Thigh	716.15, 719 (.05.,15.,45), 726.5	718(05.,15.,85.,95)	733(14.-15)	727.65	718.35
		Knee, Lower leg	716.16, 717.7, 719(06.,16.,46), 726.6	717(0-6.9), 718(06.,16.,86.,96)	733(16..93)	717.8, 727(66-.67)	718.36
		Ankle, Foot	716.17, 719.(07.,17.,47), 726.7, 728.71, 734	718(07.,17.,87.,97)	733.94	727.68	718.37
Unclassified by Site	Others and Unspecified	Other specified/Multiple	716(18.-19), 719(08-.09.,18.,19.,48-49), 726.8, 727.2	718(08.,09.,18.,19.,88.,89.,98.,99)	733.19	727.69	718(38.,39)
		Unspecified Site	716.10, 719(00.,10.,40), 726.9, 727.3, 729.1	718(00.,10.,80.,90)	729.2	733(10.,95)	727.60, 728.83
							718.30